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Nanoscale scanning probe ferromagnetic resonance imaging using localized modes¹

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We report the demonstration of scanned probe ferromagnetic resonance imaging (FMRI), a new technique based on Magnetic Resonance Force Microscopy that offers a window into nanoscale properties of buried ferromagnets. Images have been obtained with a current resolution of 200 nm, and significant improvements are straightforwardly possible. Ferromagnetic Resonance (FMR) is a powerful spectroscopic tool for studying internal magnetic fields, interactions and dynamic magnetic properties of ferromagnetic systems, but conventional FMR measures global properties of an entire sample. In FMRI the “magnetic field well” created by the probe tip field confines the spin wave modes; these can then be scanned to obtain FMR images. This new microscope is unique in its ability to map internal magnetic fields in buried ferromagnets with spectroscopic precision and nanoscale resolution. First images in permalloy films reveal the ability to image inhomogeneities in magnetic properties with field resolution of approximately 1 Gauss/ $\sqrt{\text{Hz}}$. We report a first application to imaging the internal exchange bias field in exchange-biased films.

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